Ontario Department of Agriculture

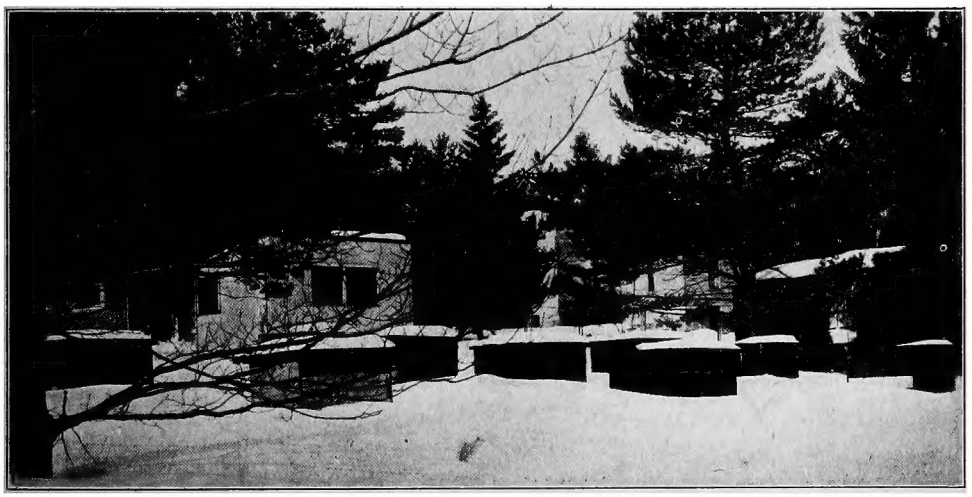
FRUIT BRANCH

BULLETIN 256

The Wintering of Bees in Ontario

By

MORLEY PETTIT, Provincial Apiarist



Snug in their winter home these bees require absolutely no care from October till April.

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The Wintering of Bees in Ontario

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INTRODUCTION.

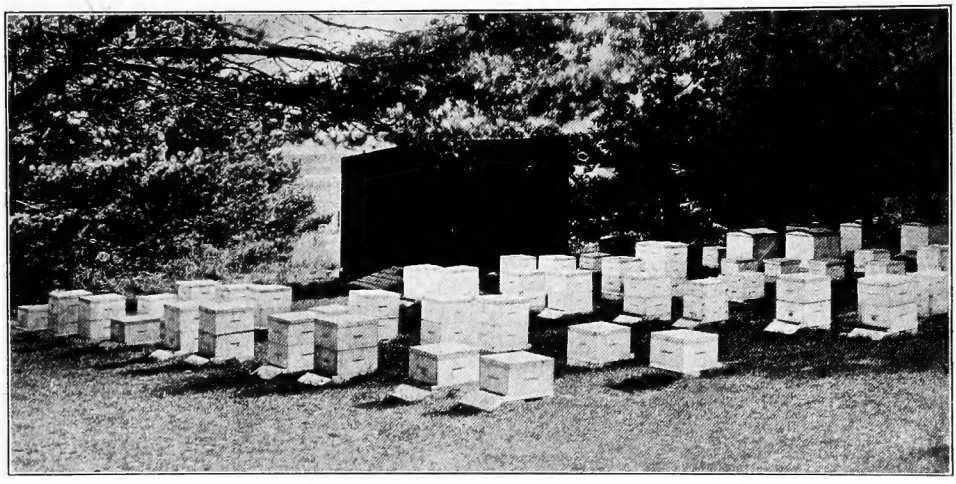
The beekeepers of Ontario lose from 10 per cent. to 50 per cent. of their colonies through winter loss and "spring dwindling" every year. The colonies which survive, being subjected to the same conditions, are weakened in population and vitality in the same proportion. This is an enormous waste which, if applied to other live stock, would be ascribed to some epidemic. The majority of beekeepers, however, take the smaller loss as a matter of course, and the larger with plans to do better "next year." It would be surprising that the heaviest loss usually occurs in the southern counties, if one did not remember human nature, and the fact that bees *will* winter there after a fashion in an average winter without protection. They are, therefore, not protected, and the periodical "old fashioned" winter takes off 75 per cent. of them, completely destroying many whole apiaries.

The bee literature of America for a generation and more has been filled with theories on the wintering of bees and the causes of loss. Many of these theories have since been exploded or ignored; but, as a result of countless experiments and a free interchange of ideas, successful beekeepers have developed methods of wintering founded on principles which recent scientific investigation is proving to be in the main correct. It would be useless, and often unfair, to attempt to give credit to the originators of different methods or ideas. Like hive-nectar in a honey-flow, these are free currency amongst beekeepers who read and attend conventions, and when credit is given, the inventor is liable to be ignored and the copyist made famous.

It has been well said that bees cannot be managed by rule, as they never do things invariably. No doubt, if we understood all the factors of environment and the influence of each on bee-behavior, we could say that, given such and such conditions, and bees will behave so and so. In wintering bees in Ontario, beekeepers follow two opposite plans. Some place their bees in a repository, such as a cellar underground, where they attempt to keep them inactive by trying to control all the factors of environment, such as light, temperature, ventilation, etc., until such time as the season and weather permit them to resume their summer activities. Others protect the hives on their summer stands, leaving the bees free to come out and fly whenever weather permits. Both of these plans, when carried out intelligently, have been found to yield good results, and while much is yet to be explained in this difficult problem successful wintering has been more nearly reduced to a "rule of thumb" than almost any other branch of bee management.

PRINCIPLES OF SUCCESSFUL WINTERING.

As all good rules are based on sound principles, it will be profitable to call attention to some of the principles of wintering before describing methods of applying them. It has been well said by the authors of Farmers' Bulletin 695 of the United States Department of Agriculture: "Causes of the death of individual bees or a colony of bees in winter, barring unusual accidents, are only two in number: first, inadequate stores, and, second, excessive heat production." It has been shown by Phillips and Demuth, the authors of the above-mentioned bulletin, that at hive temperatures between about 57° and 65° Fahrenheit a normal broodless colony of bees does not form a cluster, but the bees remain inactive on the combs. When the hive temperature falls below 57° Fahrenheit the bees form a cluster, and those in the centre begin to generate heat by muscular activity, while those in the outer portion serve as insulators by crowding close together, usually with their heads towards the centre of the cluster. The innermost portion rapidly



O.A.C. apiary in summer. Note that alternate rows face in opposite directions, and hives easily form groups of four for winter packing.

acquires a temperature considerably higher than that of the air about the bees before clustering was necessary, often going to 90° Fahrenheit in normal colonies and higher in abnormal ones. The muscular activity necessary for heat-generation causes increased consumption of stores; this, in turn, causes an accumulation of fæces within the bees, which is more rapid if the stores contain a high percentage of indigestible materials, and the presence of fæces causes discomfort, which increases activity, often resulting in death from excessive heat generation. When the accumulation is so excessive that the bees are unable to retain the fæces, there is a discharge in and about the front of the hive, and the colony is said to be affected with dysentery. Mild days, which allow bees to fly freely and discharge normally reduce the danger of loss from this cause.

With this general explanation it may be stated that the successful wintering of bees depends on the bees, the stores, the hive, the immediate surroundings of the hive which we may call the location, and the general surroundings, including latitude, climate and weather.

The Bees.

Bees may be compared to minute "dry batteries." Each is "charged" with so much vital energy which, when expended, cannot be replaced. This should be used in profitable labor, such as gathering nectar, secreting food for larvæ or wax for comb, and so on. In the working season bees expend their portion of energy and wear out in a few weeks. Those which emerge in autumn, after the season's work is over, are expected to conserve their energy for the spring brood-rearing, expending as little as possible in maintaining colony temperature during winter. Young bees, with their full "charge" of energy are, therefore, most desirable in autumn, and there should be plenty of them to divide the responsibility of retaining favorable cluster conditions during the winter. The queen should also be young and vigorous to insure rapid development of colony strength in spring.

View of O.A.C. apiary giving prominence to single cases. These are more expensive and their use is largely a matter of preference.

The Stores.

As bees do not discharge the refuse from the digestion of food, except in flight, this is retained in the intestines during the cold months of winter. With this in view it is easy to see the importance of supplying the colony in winter with stores containing the smallest percentage possible of indigestible matter. The best quality of honey well ripened is considered a good winter store; unfortunately, we are not always sure what has been stored in the brood-chamber during the autumn months. Sometimes bees gather from sources which do not give the best of stores. They may gather it during the cool weather, when they are not able to ripen it properly, and a degree of fermentation may result. Such stores as this are liable to cause dysentery in the winter. Sometimes these inferior honeys granulate readily in the brood-chamber during winter, and this granulated honey is sure death to the colony. If, on the other hand, we give each colony ten pounds or more of syrup made from pure sugar rather late in the fall, we are sure of the kind of stores they have next the cluster, and know that, so far as food is concerned, the colony will winter successfully.

It is found good practice by many of our most successful beekeepers to leave extracting supers on the hives as long as the bees are liable to be gathering anything. When the supers are removed this takes away most of the honey they have been storing, leaving the brood-chambers rather light and ready for a heavy feed of sugar syrup. Each colony is then fed as much sugar syrup as it will take up to 40 or 50 pounds. It is then known to be in good condition so far as the stores are concerned.

The Hive.

The hive should be suited to the size of the cluster. It should be either warmly packed with good, dry material or placed in a cellar, and should be well ventilated. The entrance should never be closed, but should be contracted if sufficient upward ventilation is given. Those who practice wintering with sealed covers leave the entrances much larger than those who have upward ventilation. It is better to have the entrances so arranged that mice cannot enter the hive during winter. An entrance not more than $\frac{3}{8}$ inch wide will make this practically sure.

The Location.

This is, to a large extent, beyond the control of the average beekeeper. He keeps his bees where he lives. But for commercial beekeeping great care should be exercised in choosing a locality. While the presence of an abundant honey flora is the first consideration, spring sources of nectar and pollen play an important part in bringing the colonies up to the main honey flow in the best of condition.

The latitude does not make so much difference as one might think. Colonies properly put away seem to winter about as well in the north as in the south of Ontario, only of course the northern bees require more protection and consume more food.

For outside wintering the apiary should be dry and sunny, and especially should be sheltered from cold winds. If a natural windbreak is not available an artificial one of some kind should be put up. Some use a latticed fence six or eight feet high. When sheltered from winds this way it does not matter very much which way the hives face. Many prefer a southern exposure, but it is largely a matter of convenience. In some apiary arrangements, where alternate rows face in opposite directions, the rows are placed to run north and south facing the hives east and west. This gives every entrance some sun during the day. Naturally the northern entrance is more objectionable than any other. An apiary in winter should not be disturbed by cattle or other things travelling about and jarring the hives. Complete quiet and absence of outside disturbance is one of the important factors in successful wintering. Where bees are wintered in a cellar the place should be kept dry and totally dark. It should be carefully ventilated to keep the air sweet at all times, and the temperature should be kept at about 40° to 45° F. The rule of avoiding disturbance applies even more to cellar than to outside wintered bees.

METHODS OF OUTDOOR WINTERING.

The elements of success in wintering bees have now been outlined, and the beekeeper may winter his bees in any way he likes, so long as he observes these principles. He may winter out of doors or in the cellar, and if out of doors he may place packing around each hive separately or around groups of two, four, six, eight, or any other number that suits his convenience. Many successful winterers use the individual case, others pack two in a case, and others four in a case. Larger cases than these are not recommended as being less convenient in many ways. In addition to the points mentioned above it is important to note that the hive should not be moved far from its summer stand for packing. The winter cases make sufficient change in the appearance of the apiary to cause the bees enough confusion when they fly afterwards without also changing the location of their entrances.

The Quadruple Case.

The quadruple case described in the following paragraphs has been found very successful by a number of beekeepers. The four hives are placed tightly together in one box, two facing east and two west. This box provides for about 3 inches of packing on all sides of the four hives, and 8 or 10 inches on top. There is no packing between the hives or under them. The stand, which is eight inches high and made solid, prevents drafts of air underneath. The entrances open out through the sides of the box, so the bees are always able to fly when weather permits. They are packed up as soon as possible after supers are off. then fed all the sugar syrup they will take early in October.

Preparation of Hives.

The size of the box will depend on the dimensions of the hive used. The ten-frame Langstroth hive as made in Ontario is 20 inches long, 16⅝ inches wide and about 9½ inches deep. The bottom-board is 22½ inches long and 1¾ inches deep. These are outside measurements. The space inside the bottom-board is ⅝ inches deep. If the frame-rests in these hives are so arranged that the tops of the frames are even with the tops of the hives, that is, if the beespace is underneath the frames, the space between the bottom-bars and the floor of the bottom-board will be about one inch, which is sufficient for wintering. If, however, the beespace is above the frames and the bottom-bars come even with the bottom of the brood-chamber the space will be only ⅝ of an inch, and should be increased by tacking half-inch strips on the rim of the bottom-board all around, or by using the wedges which are frequently used to enlarge the entrance for swarm control in summer. The entrance of the hive is left full width and this extra depth all winter. The projecting bottom-board is bridged over by means of a ⅜-inch board, 2½ inches wide and 16⅝ inches long, laid flat, and extending from one side rim to the other, so as to make a tunnel from the entrance of the hive to the flight hole in the end of the box. After all four hives have been fixed in this way they are ready to put into their box.

The Wintering Box and Stand.

The wintering box consists of the floor, two ends, two sides and the roof, all finished with cross cleats, so that each is a separate piece which can be taken down and piled flat with the others when not in use. Seven-eighth inch matched lumber is used throughout. The sides and ends are placed outside the floor to turn the rain, and are supported by the corner cleats which rest endwise on the corners of the floor. The inside dimensions of the box are 24½ inches deep, 40 inches wide and 45½ inches long. It has a flat roof projecting 4 inches on all sides and covered with prepared roofing. This box is placed on a stand about 8 or 10 inches high, made of four boards ⅞ inch by 8 or 10 inches, nailed into a rectangle. The ends are cut 40 inches and the sides 45½ inches long.

They are nailed up with the shorter pieces nailed on the ends of the longer ones, and the outside dimensions of the resulting stand are 40 inches by 47¼

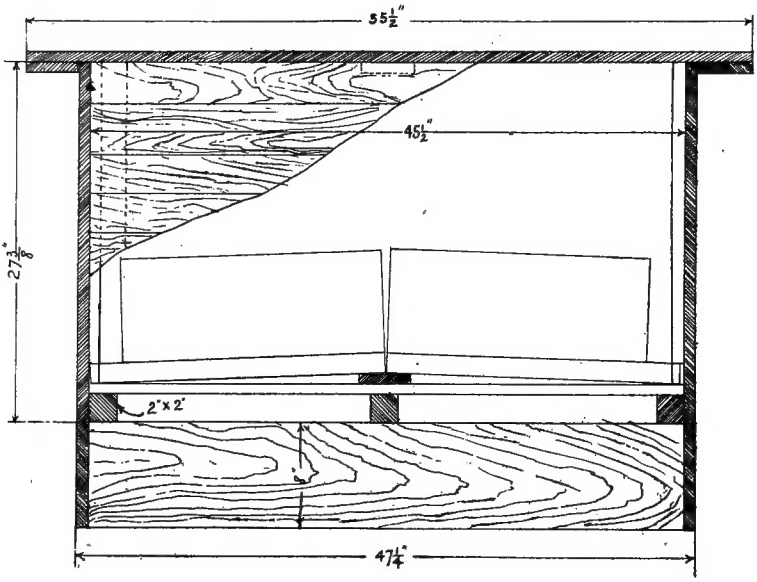


Fig 1.—Side elevation of 4-hive Wintering Box, with side cut away to show construction.

inches. To make the floor of the wintering box, first lay down three pieces, each 2 inches square by 40 inches long; then nail on these ⅞-inch matched lumber, cut 45½ inches long, making the floor 40 inches by 45½ inches. It will be seen that when this floor is laid on the stand it comes just even with it at the sides, but is ⅞ inch short of it at each end. In other words, the outside length of the stand and of the wintering box are the same, making a smooth surface from the ground up, where the bees have their flight holes, but the stand is made narrower as a convenient way of supporting the cross cleats of the floor.

After the stand, with the floor in place, is levelled up with a spirit level, using scraps of thin lumber under the corners, a board ⅞ inch by 4 inches by 36 inches is laid flat across the middle of the floor to support the backs of the four hives, giving them a tilt forward toward the ends of the box. The four hives are placed close together with the four corners meeting at the exact centre of the floor. The

front ends of the bottom-boards will then come just about to the edges of the floor, and should almost touch the ends of the box when they are put in place.

The wintering box is made 24½ inches deep inside, so the hives can be supered, if necessary, before they are unpacked. As the outside dimensions of the floor are 40 inches by 45½ inches, these will be the inside dimensions of the box, whose sides and ends must project down over the floor about 2⅞ inches to cover it and its cross supports, and leave no opening between it and the stand. Each side and each end of the box will need an upright at each end of it, ⅞ inch by 2 inches by 24½ inches, and if these are all placed ⅞ inch back from the end of the lumber a locked joint will be formed which will not admit dampness. (See Fig. 3.) The sides of the box are 45½ inches long by 27⅜ inches high. The ends would be 40 inches plus ⅞ inch at each end to cover the ends of the sides, against which they are clamped or nailed, or 41¾ inches long by 27⅜ inches high. When these two sides and two ends are made up and placed together, the outside dimensions of the box thus formed will be 41¾ inches by 47¼ inches.

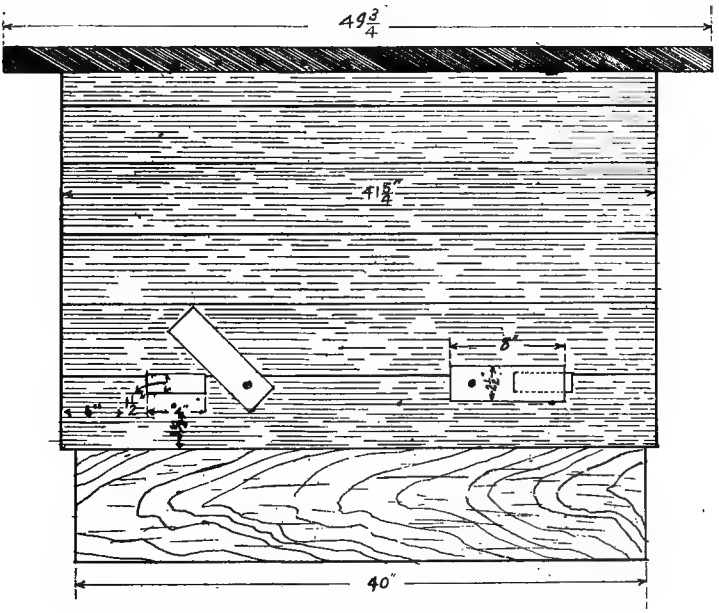


Fig. 2.—End Elevation of 4-Hive Wintering Box, showing arrangement of Entrances.

After the ends are made up the entrance holes should be cut. These must come opposite the hive entrances and should be as deep as the bridge will allow, but need not be the full width. They are placed as far apart as possible to prevent bees mixing when they fly. Measuring 6 inches in from each end and 3⅝ inches up from the lower edge of the box-end locates the lower outer corners of the two entrances. The holes are then cut 4 inches long horizontally, and 1½ inches high. In cold weather each is reduced to a vertical entrance ⅜ inch by 1½ inches by means of a piece of thin board 2½ inches by 8 inches, fastened with a screw or an ordinary wire nail on which it turns as on a pivot. When closed down it comes ⅜ inch short of closing the opening, leaving the ⅜ inch by 1½ inches vertical entrance. A nail driven just below it prevents its coming

down too far. When raised up the opening is full size for cleaning out dead bees, or for ventilation on hot days in spring or autumn. The vertical entrance is less liable to clog with dead bees or ice than the horizontal one would be.

The roof is made perfectly flat and large enough to project 4 inches on all sides. That is, it is 49¾ inches by 55½ inches, allowing ¼ inch for play. It is made of ⅞-inch lumber, with a 4-inch cross piece of the same material at each end and in the middle. The middle cross piece should be just 40 inches long, to fit inside the box; the end cross pieces fitting outside, and forming a telescope projection ⅞ inch deep, to prevent dampness from drawing in underneath.

The cover should fit closely enough to exclude mice, but should have openings underneath sufficient for the air to draw through over the packing, and take away moisture arising from the bees. This cover is overlaid with prepared roofing.

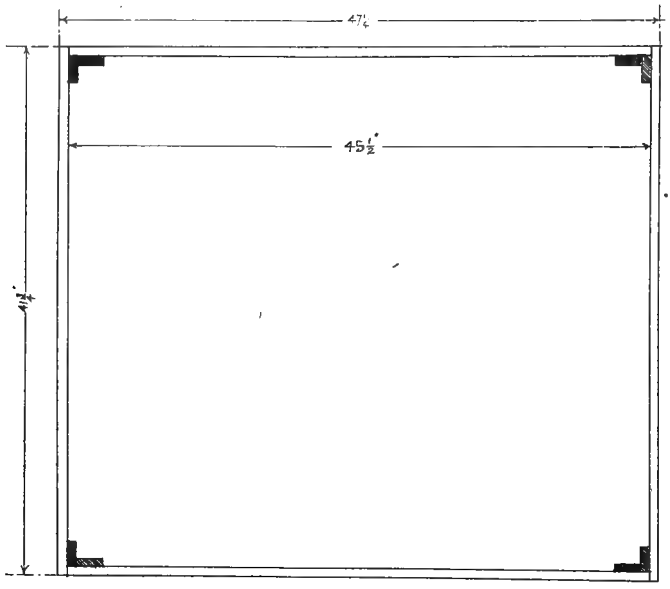


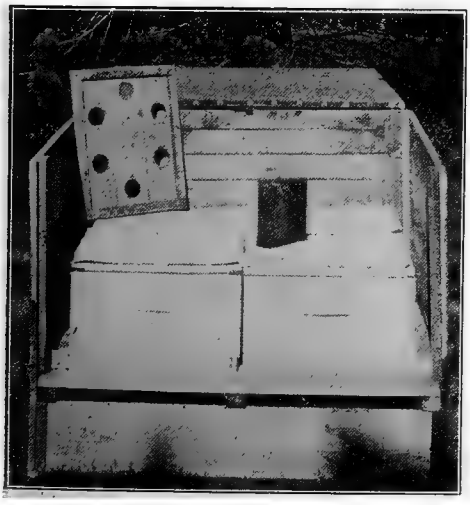
FIG. 3.—Outline of 4-Hive Wintering Box, showing weather-proof joint at corners.

PACKING THE HIVES.

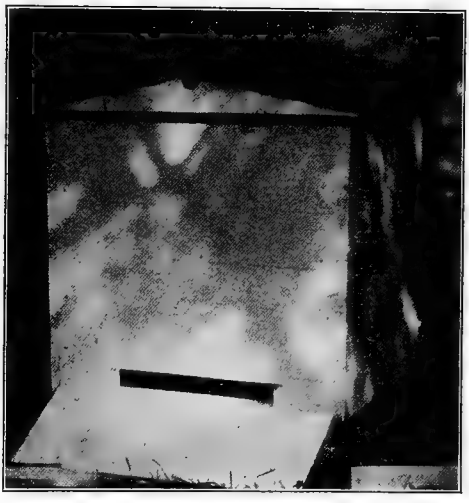
When the four hives are in place on the floor of the winter box, with their entrance bridges adjusted, the sides and ends of the box are set up and fastened at each corner with three clamps, hooks or wire nails. The bridges must fit closely to prevent packing material clogging entrances. If the bees can reach this material at all they will dig out quantities of it and perhaps choke their own entrance. The summer cloths or honey-boards are next removed and replaced by feeder-boards (to be described later) with burlap spread over them and two or three thicknesses of newspaper over that. The packing is then filled in and crowded down well on all sides until the box is filled to within two inches of the top. At no time must the material touch the roof. The air must circulate freely over it to prevent dampness collecting.

The best packing material is cork chips, which can sometimes be obtained from fruit stores handling Spanish grapes. Forest leaves are excellent, and planer shavings or chaff are good; but sawdust, clover chaff or anything which draws and holds dampness should be avoided. Some use straw, but it is too open and cold unless cut fine.

The collapsible wintering box makes hive-lifting for packing and unpacking very easy. The stands shown are in their permanent summer location.



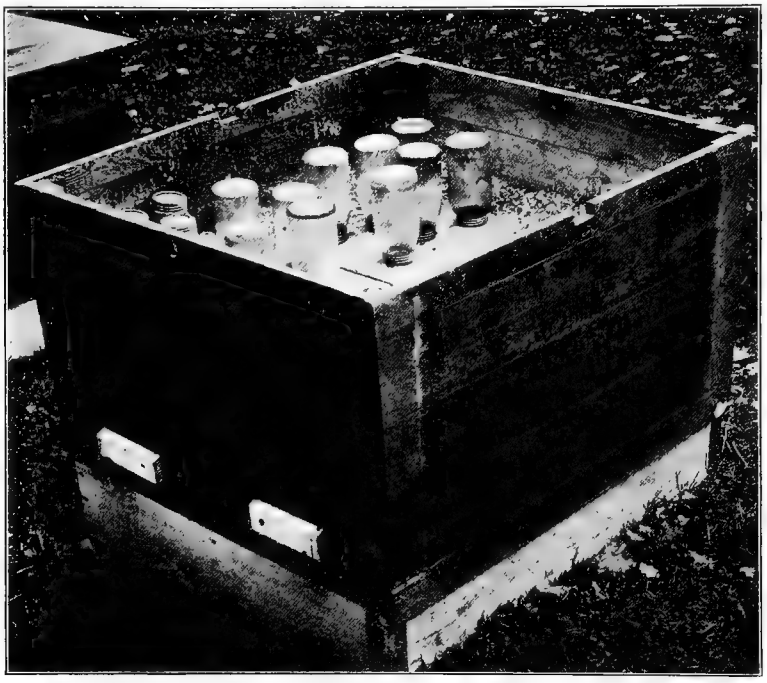
The hives in place and three sides of case set up. A feeder-board is shown, also one feeder pail.



Single wintering case, with large entrance used in summer. This entrance is greatly reduced in winter.

FEEDING FOR WINTER.

At all times during summer and early autumn care should be taken to see that colonies do not starve. So long as they have enough for daily food winter feeding should be delayed until the first half of October. Each hive should then be given all the syrup it will take. This may be anywhere from 10 pounds to 40 or 50 pounds, depending on the strength of the colony and the amount of stores it already has. The syrup is made of two parts best granulated sugar to one of water. Boil the water, then add the sugar and stir till thoroughly dissolved. The only points to be observed are to avoid scorching the sugar and to see that no granules are left in the syrup to start crystallization after it has been stored in the combs. The feeder consists of the feeder-board and atmospheric feeders. The



The four hives have been packed on sides, feeder-boards are in place and 2-quart fruit jars with syrup inverted over them. In cool weather packing material is filled in amongst the feeders to conserve hive temperature. If this is not done the bees will not take the feed. When the jars are empty they are removed.

board is made of ⅜-inch lumber cut 16⅝ inches by 20 inches, to fit the hive like a honeyboard. Circular holes 2½ inches in diameter are made in it for the feeders with key-hole saw or extension bit. When in place there must be a bee-space over the frames. If the hive does not provide this a ⅜-inch rim is nailed to the board. The feeders are two-quart fruit-jars covered with cheese-cloth held on by the ring, or ten-pound lever-cover honey pails, with a number of small, holes punched in the lids. When these are filled and inverted over the holes in the feeder-board, atmospheric pressure prevents any leakage, and the bees take the syrup through the cloth or perforations and store it in the combs.

When feeding time comes in the early part of October, the packing is removed from over the feeder-boards and a number of filled pails or jars are inverted over the holes. If the days are warm this is done towards evening to prevent robbing, and if the nights are cool packing is put around the feeders to hold the brood-chamber heat and help the bees take down the feed. As fast as feeders are emptied they should be refilled, until the bees signify that they have enough by ceasing all work on the feeders. The latter are then removed, the burlap, paper and packing are replaced, and the roof is adjusted for the winter. The feeding may take a week or more in cool weather, but should be gotten through with as rapidly as possible after it is once started.

If these directions have been followed carefully the bees will require no further attention until spring. In fact, some extensive beekeepers prepare their bees in a similar manner, then go to the city, and do not see them again till May. It is better, however, to visit the apiary frequently, not to disturb the bees in any way, but to see that no accident has happened, such as fence blowing down, covers off, etc. When a warm day occurs towards spring and the bees are flying, the entrance doors should be raised and dead bees raked out with a wire. Snow drifting over the box may do no harm, but uniformly good results are obtained by not allowing it to be higher than the entrances around the box.

CELLAR WINTERING.

A few years ago this was the most popular method of wintering bees in northern climates. Most beekeepers in Ontario and in the Northern States considered that their bees wintered more successfully in cellars than out doors. Since methods similar to that described above for wintering out of doors have been perfected the tendency is all the other way and out-door wintering is being practised successfully as far north as bees have yet been kept in New Ontario. There are still many, however, who have cellar space under dwellings or in similar places suitable for wintering bees which can be used at little expense in preference to making up cases for wintering out doors.

In general terms the conditions required for successful cellar wintering are: first, total darkness; second, an even temperature, at which the bees will remain perfectly quiet. This is usually found to be about 40° to 45° F. The cellar can be kept this way most easily when it is nearly all underground, as it is then less subject to the outside changes which occur from time to time during the winter. The cellar air should be kept pure by a proper system of ventilation, and should be neither too dry nor too damp. The hives themselves should have good ventilation, which may be obtained by removing the summer covers and placing light, porous packing on top, such as a layer of felt, a cushion of chaff, or something of that nature. Many find it an advantage to pry the hives from the bottom-board and block them up with ⅜-inch blocks at the back, allowing a current of air to pass from the entrance across under the cluster and out the back. The hives may be piled one above the other on stands which keep the lowest hive at least one foot above the cellar floor. In fact the best wintering is usually found nearest the ceiling of the cellar.

The bees should be carried into the cellar just at freezing-up time, preferably the next day after they have had a good cleansing flight. In Southern Ontario this would be the latter part of November and earlier in the more northern latitude. It is only injurious to bees to leave them on their summer stands during freezing weather in the fall, when they are to be placed in a cellar. On the other hand, if warm weather occurs after the bees have been carried into the cellar, it is often difficult to keep them quiet. In fact the uncertainty of weather for setting in in the fall and for carrying out in the spring is one of the chief objections to cellar wintering, if one adds to that the fact that the cellar requires a certain amount of attention in the way of regulating ventilators all winter. Then, when the hives are removed from the cellar in the spring they have to pass through inclement weather without the protection they should have, for they require about the same labor and expense for packing up as they would have required in the fall if wintered on their summer stands.

Row of quadruple cases with entrance doors open as in warm weather of spring or fall. These doors close ⅜-inch short of ends of openings leaving winter entrances ⅜-inch wide by 1½ inches high.

Setting Bees Out of Cellar.

Setting bees out of the cellar in spring seems like a small matter; but a mistake made at this time often brings disastrous results. The date, the day and the weather are all subjects for careful choice. There are certain principles connected with the behavior of bees which must be considered in setting them out of the cellar. These may be enumerated before discussing the time and manner of the operation.

Under the most favorable conditions, bees in winter remain quietly clustered on their combs, consuming very little food and rearing no brood. Unfavorable conditions of temperature, humidity, etc., also improper food, cause uneasiness indicated by a buzzing or humming sound in the cellar, brown stains of dysentery

on hive fronts, and an increased death rate of individual bees. The uneasiness raises the cluster temperature to the brood rearing point, and brood rearing adds to the sum total of activity, causing increased consumption of food and increased accumulation of fæces, which the workers are unable to void except in flight. The flight of healthy bees in a cellar is prevented by darkness and a low temperature; but those which have become diseased by an overload of fæcal matter either develop dysentery and discharge at the hive entrance or fly out into the dark, or to a light carried by an observer, never to return to their hives. This flight of individuals is another indication of poor cellar conditions.

The date of setting out will depend on the condition of the bees and of the season. Colonies which contained mostly young bees and good stores the previous autumn will, in favorable cellar conditions, endure and profit by a longer confinement than others not so fortunate. In visiting the cellar to judge conditions, no kerosene light should be used on account of the odor, but a small electric light or wax candle. When bees are quiet and not showing dysentery, they should be left in until snow is gone from the yard, and there is something for them to gather outside. The melting of snow can be hastened by shovelling it about whenever it thaws. The usual rule is to wait, if possible, until soft maple blossoms begin to open.

Carrying bees out in January or February for a winter flight, then returning them to the cellar, was tested quite thoroughly some years ago, and condemned as poor practice. Where bees cannot be successfully cellar-wintered without this they should be packed and wintered on their summer stands.

When the approximate time of setting out has been decided upon, the day and hour must be selected. In making a selection we must take into account the tendency of bees to become excited when first brought out of the cellar into daylight. This excitement is increased by a restless condition of the bees previous to bringing out, by jarring and delay in carrying, and by the day being very warm. It may be reduced by opening doors and windows the previous evening to give the cellar a good cooling off overnight, by handling the hives very carefully to avoid disturbance, and by selecting a day which is not too warm. It should be noted that excessive airing of the cellar in spring, while it provides temporary relief, will ultimately increase the uneasiness unless the hives are soon taken out. The first flight of the bees should be accompanied by sunshine, still air, and a temperature of 50° to 60° F., indicated by a thermometer hanging in the shade. Excitement, causing large numbers of bees to fly at once, is liable to result in drifting, particularly if the wind becomes strong. By "drifting" is meant many bees going into certain hives, making those colonies too populous and depleting the strength of others.

This term requires some explanation. When a young bee comes out of its hive for the first time in the summer, it will be seen to turn its head toward the entrance upon taking wing, flying in front of the hive in circles, each circle growing larger as it goes further from the hive until it is lost to sight. In this way it impresses upon its memory the exact spot of "home." On subsequent trips these precautions are not taken, and it leaves its hive in a direct line of flight, never looking back. If the hive is afterwards carried to a new location on familiar ground less than a mile away, the older bees do not usually notice the change, but return from flight to the exact spot where they first marked their home, there to die as homeless martyrs, unless there are other hives near at hand to receive them. There are occasions, however, in the lives of bees when the

memory of the home site seems to be subordinated. These are occasions of great excitement, as in swarming or of long confinement, as in winter. In neither of these cases is the memory of the old home site entirely lost; but when first taken out of the cellar they usually orient themselves, as in their first flight as young bees. The impulse to guard the hive against strange bees is also subordinated on both of these occasions.

An additional factor in the return of bees to the hive on such occasions is the "homing call." Each worker is provided with a small gland located just above the tip of the abdomen. Under the excitement of a first flight or swarming, bees alighting on the entrance of a hive raise the tip of the abdomen, exposing this gland, and fanning with their wings to drive off a scent which attracts others. They also utter a peculiar hum, which has been called the "homing call." Whether it is the scent or the sound which attracts other bees we need not discuss here; but this call causes numbers of bees to alight near the callers and enter the hive, even though it is not their own. When conditions in the apiary are favorable with warm sunshine, still air and not much excitement of the bees, the call from the various entrances is about the same, and no confusion results. The bees, in flying out, have taken note of the location of their hive, much as on the occasion of their first flight as young bees, and return mostly to their own hives; but where the excitement is great they do not orient themselves well on going out, and if a strong wind strikes up it drives the "homing call" across the yard, so that bees are called to the windward side and drift in large numbers up against the wind to the hives on the far side. The result of this drifting is a large number of weak colonies, and a few colonies which have more bees than they should have at this season. Under the excitement colonies sometimes swarm out and leave their hives entirely.

That bees do not entirely forget the old location of their hives is indicated by the following observation reported by different beekeepers with variations. On the first flight of bees after the hives are removed from the cellar, it has been noted that numbers of bees sometimes hover about stands which were occupied in the fall, but are now vacant. These are believed to be workers from hives which formerly stood here and now stand elsewhere. It is inferred from this that a general interchange of bees occurs where all stands are reoccupied, but not by their former hives. If this occurs to any extent, and the evidence that it does is fairly conclusive, several dangers are incurred by not getting each hive back on its former stand. An infectious disease existing in a few hives of the apiary is liable to be spread to other hives, queens may possibly be killed by strange bees, and the defence of each hive against robber bees may be reduced by the confusion. It seems important, then, that hives should be carefully returned to their original stands, even though many successful beekeepers do not consider the advantage worth the extra trouble.

Another matter of importance is the robbing impulse which must be guarded against until nectar is gathered regularly from flowers. The impulse to defend the entrance is at a low ebb during the first general flight and there is danger that bees from hives which have been wintered out of doors, or have been set out previously, will rob the ones which have just been brought out. As far as possible all the hives of one apiary should be carried out on the same day.

A few days before setting out it is good practice to go through the cellar, and mark the hives where bees are restless, or where many dead bees are accumulated on the bottom board. As the hives are carried out all light ones should also be

marked. The percentage of such abnormal colonies in a well-regulated cellar will be small, and, after they are set out, only these need be disturbed by changing bottom boards, giving feed, or examining for queen condition. The danger of robbing and exposure to cold in giving immediate attention to the apiary will thus be greatly reduced.

As the flight of bees is very subject to temperature, light and wind, the weather for setting out must be carefully considered. In fact, the beekeeper needs to be a student of the weather at all times, also of the daily reports of the Weather Bureau. One of the best means of forecasting the weather is to study sunsets. It is not easy to describe the sunset which forecasts a bright or stormy day; but, by taking note of the general appearance of the evening sky and noting the sort of day which follows it, one soon becomes a rather good weather prophet.

Birdseye view of O.A.C. Apiary in summer. Note hives in background left in single cases. Some consider summer packing a factor in swarm control. Supers are added within the case.

The usual time for taking bees out is the evening before or the morning of the day which promises to be fine and still, but not too hot. When such a day is expected the doors and windows are opened at sunset to cool the cellar. The hives may at once be placed on their stands by moonlight, or in the early morning, while the air is still frosty. If the day fulfils the beekeeper's expectation it will be still, bright and moderately warm, about 60° to 70° F. The bees will have a splendid flight, and everything will go well.

Unfortunately, however, spring weather is uncertain, and if, when the air is full of flying bees, the sky becomes overcast and the temperature begins to drop and a stiff breeze strikes up, much drifting will result and many bees may be blown on the ground to chill and die. In small apiaries this danger is reduced to a minimum, but where there are many colonies it is safer to select a time when indications are for dull weather for two or three days. Then, at sunset, start carrying out the hives and continue until they are placed on their summer stands, even if it takes until after midnight.

In either case the entrances should be contracted to from one to four inches, according to the strength of the colony, covers properly adjusted, combs of honey given to colonies which are light, bottom boards which are much dirty changed, and other such adjustments made at once. By morning the bees will have been quietly clustered and will not leave the hives to any extent until the weather warms up and favorable flying conditions prevail. This usually comes gradually and prevents the excitement and drifting which occur under the unfavorable conditions previously described.

No particular ceremony is needed in carrying hives out, particularly at night. The only precaution is to work quickly and avoid disturbance as far as possible. Do not allow unnecessary light in the cellar, and do not jar the hives. If there are many hives there should be two or three persons to carry. Let each man pick up a hive in his arms in a comfortable position, carry it gently and quickly to its stand, set it down and come back for another. If the carrying out is being done in daylight, it is best for one to attend to the cellar door, standing right there to open and close as the others pass in and out, thus avoiding unnecessary light and disturbance in the cellar. Even then if the morning is inclined to be warm, the bees in the cellar may become restless, and in that case the door should be left closed for some time after every period of fifteen or twenty minutes carrying out, while the bees in the cellar become quiet and the operators are adjusting entrances, covers, etc., on the hives which are out.

In case cellar conditions have been very unfavorable, so that these ordinary precautions will not keep the bees from flying from the hives or coming out to sting the operator while they are being carried out, the entrances can be closed with a cloth, wet with cold water, and some smoke blown into the hive to quiet the bees. This use of a wet entrance closer and smoker is advised also for timid persons; but under normal conditions of bees and beekeepers is quite unnecessary.

It is well known that bees, in their first flight, discharge the fæces which has been retained in the intestines during the winter, and care should be taken that nothing in the way of clothing or the like be left exposed in the apiary or neighborhood. It is very annoying to a neighbor who has put out a fresh washing on the line to have it stained by the droppings of bees, so as to make rewashing necessary. Where there are near neighbors they should be warned of this danger. It has been one of the most serious causes of trouble between beekeepers and their neighbors.

In conclusion, I would emphasize the importance of favorable cellar conditions for wintering, then leaving the hives in just about as long as the bees can be kept quiet or until near the opening of soft maple bloom. Then, in carrying out, disturb them as little as possible, pack them up snug and warm, see that they have sufficient stores and let them alone for some time.

Spring Protection of Cellar-Wintered Bees.

Once upon a time there were two farmers living side by side. Both had equally large farms, with heavy crops of grain. The one had an adequate staff of harvesters ready when the grain began to ripen, and saved his whole crop. The other did not think much about securing help until the first field was ready to cut. Then he began scurrying about getting a man here and another there; so that by the time the last field was harvested and most of the early grain had spoiled in the field, he was boarding a full gang of harvesters who were no longer needed.

Another time there were two beekeepers, each in a good location. The one took good care of his bees and had the hives full to overflowing with workers when the honey flow started. At the end of the season he had a large crop. The other neglected his bees, and the spring weather being unfavorable, they were just about as weak on the 10th of June as they had been in April. Of course they built up during the honey flow and were in good shape for winter that fall; but another season's crop had been lost, owing to lack of proper care at the right time.

There are several things that have to be taken into account in the spring management of bees. They may "spring" poorly because they have wintered poorly, leaving the hive with only a few bees of weak constitution. The hive may be in an exposed place, where persistent winds keep the inside temperature down and compel the nurse bees to huddle together, thus restricting the size of the brood nest; or the cover of the hive may be thin and open, allowing the heat to pass up

A commercial apiary wintering in quadruple cases. Note windbreak made of lath nailed on frames 6 feet by 8 feet. These may be removed and stacked in summer, and are easily transported in case of moving an apiary.

and out. On the other hand, the brood-chamber may be crowded with old honey, depriving the queen of laying space, or feed may be so scarce that the bees have a job to keep themselves, let alone feeding the brood. They may have a poor queen. Any or all of these conditions are liable to prevail, and cause the beekeeper heavy loss where he goes entirely on the "let alone" plan.

The queen condition of the colony should be watched during summer, and although queens brought from the South can be introduced in April or May, it is much better to have a good queen in the hive to start rearing brood earlier than that. Stores sufficient for winter and spring should be given in the fall, but can be given in spring if necessary.

It is frequently stated that the life of the worker bee is anywhere from six weeks to six months, depending on the amount of work that it does. Bees do not

build up strength and increase their powers of endurance by healthful food and exercise as animals do, but each bee arrives in this world supplied with about the amount of energy it will expend during its life-time. We have compared bees to small, dry cell batteries, with just so much energy stored. This energy can be saved by having ideal conditions in the hive; but where conditions are not ideal for brood-rearing, the worker bees must improve them by an expenditure of energy which shortens their own lives. The temperature at which a broodless colony remains quietly clustered is about 57° F. When the outside temperature drops below that, as it does on frosty nights, heat must be generated by the bees themselves within the hive. The temperature at which brood is reared is between 93° and 95° F. It will be seen that on a frosty night this is at least 60° F. above the temperature of the atmosphere outside the hive. The heat necessary for maintaining this temperature is generated by the muscular activity of the worker bees, and is the result of a consumption of food. In other words, the hive might be compared to a dwelling-house, and the colony of bees to the furnace. With this comparison in mind it is easy to understand why a hive needs to be warmly protected, especially in spring during the time that brood is being reared, and when we consider how difficult it is to heat the house on a windy day, the importance of sheltering hives from the wind will be evident. But bees do not attempt to heat the whole interior of the hive to the brood-rearing temperature. A spherical cluster is formed of bees, not closely crowded within the cluster, but forming a very compact shell by the bees on the outside crowding closely together in such a way that their bodies form a non-conducting surface to the sphere. When the difference in temperature between the inside and outside of the cluster is great, more bees are required to form the non-conducting shell, and the diameter of the sphere must be accordingly reduced. Where the walls and ceiling of the hive are non-conducting, retaining heat which escapes from the cluster, the difference in temperature is reduced, and the sphere can be accordingly enlarged. The quantity of brood which can be cared for at any one time depends entirely on the size of this sphere, and the size of the sphere depends on three things: the population of the hive, the temperature outside the hive, and the extent to which the hive itself retains the cluster heat. It is the last with which we have to deal in this chapter, and it does not seem that further explanation is necessary to show the importance of having the hive warmly protected and sheltered from cold winds during the spring building-up period.

The method of applying these principles is a matter of detail, which any beekeeper will work out for himself once he fully realizes the importance of having colonies warmly protected and sheltered from cold winds during the spring building-up period. Bees wintered out of doors should not be unpacked before settled warm weather—the latter part of May or early in June. Some are never unpacked. If wintered in the cellar they should receive protection and shelter when they are brought out. The apiary should not be a windy site at any time. The shelter of evergreens or buildings is very desirable. If such shelter is not available, it is advisable to erect an 8 foot board or lattice fence, placing the boards fairly close together. Where colonies are quite strong and the hives are sound with good, tight, warm covers, the shelter from the wind may be sufficient, provided the entrances are contracted to about one or two inches by three-eighths of an inch. Single board covers are not sufficient. In fact I do not consider them satisfactory at any time. There should be some warmer material, such as cork, felt or shavings in the cover.

One beekeeper describes his method of packing, after taking out of the cellar, somewhat as follows: He puts chaff or straw on the ground for the hives to rest on to keep the bottom dry and warm, sawdust cushions on top, straw piled up around the sides and backs, boards leaned against the straw to hold it in place, and large telescoping covers placed over each hive. If any colony is weak and does not cover the required number of combs when set out, he removes unoccupied combs, crowding the bees to the side of the hive with a division board, putting packing in behind the division board. The bees are left with this packing around them until they are strong enough to need room and ventilation.

A beekeeper writing from Northern Ontario, has a collapsible winter case, which he puts on each hive, packing with two or three inches of shavings on sides and top, practically giving the colony as much protection as many beekeepers give for outdoor wintering in Southern Ontario. The main point is to see that the hives are warmly protected and sheltered from cold winds during the period of spring building up. This seems like a little extra labor, but will be well repaid in the additional amount of honey gathered during the honey season.

SPRING FEEDING OF BEES.

Success in beekeeping depends on having the hive boiling over with workers just at the beginning of the main honey flow. This condition is obtained by conserving the strength, and thus prolonging the life of the workers which have wintered over; also, by making conditions as favorable as possible for rearing young workers. We have seen how the rapid breeding of young depends on cluster temperatures. There is another factor of equal importance which must now be considered; that is, the productivity of the queen and the nutrition of the larvæ.

Aside from cluster limitations, which depend on population and temperature, the queen's laying is affected by her vigor and the way she is fed. Her vigor depends on her original vitality and the amount of work she has done. Age and breeding are important factors here, also wintering. A vigorous queen, after her winter's rest, will lay eggs in the spring as fast as a colony can care for them, provided she is well fed. Her food is obtained from the younger workers of the hive, and is a milk-like substance produced by glands, located in the head, which pass the food down into the mouth, where it is handed out to a hungry queen or larva, as the case may be. The production of this food is quite involuntary, and depends on the amount of honey and pollen consumed by the worker bees. As the queen is producing eggs at the rate of hundreds daily, she requires frequent nourishment, and must seek it from workers about her in the hive. To a great extent her egg-laying will be in proportion to the ease or difficulty with which she is able to obtain food in this way, and that will be in proportion to the number of young bees in the hive and to the extent to which they are producing this food; and that, again, will depend on the supply of honey and pollen in the hive and the extent to which it is available. Honey which is sealed in the combs will be used by workers in the preparation of this food; but unsealed honey, or that which has just been brought in, is used more freely. It will be seen from this chain of statements, that for rapid brood-rearing in spring, it is important not only to have plenty of stores in the hive, but to have part of them not sealed and close to the cluster, so they will be handled and consumed by the workers. The handling of honey, either from the field or from feeding, must stimulate the production

of milk food by young workers. A supply of pollen in the hive is quite as important at this time as honey.

An equally important factor for the upbuilding of the colony is the proper feeding of the larvæ. This depends on the same conditions as the feeding of the queen, and if neglected would cause greater loss, as the queen can go about and look for food in the hive, but each larva remains in its cell waiting for food to be brought, and a lack of attention at the right time may result in starved brood or workers without their share of vitality.

Much as has been said and written on stimulative feeding to induce the queen to lay in the spring during the last fifty years or more, the late Wm. McEvoy, the first apiary inspector of Ontario, is about the only one to mention the importance of having the brood well fed. In the Annual Report of the Ontario Beekeepers' Association for 1892, he is reported as follows:—

"Between fruit bloom and clover I see that there is plenty of unsealed honey in the combs. If not, I feed in the evenings until there is, because the larvæ are never so well fed when all the unsealed stores are used up. In favorable weather the bees will gather abundance from fruit bloom and dandelions to feed the brood well and keep a large quantity of unsealed honey on hand. Then, right in the middle of it all we sometimes get a frost, followed by rainy weather, which cuts off the honey flow so suddenly that the bees have to use up the unsealed stores at once to feed the larvæ. Then, when the unsealed stores are used up and no honey is coming in, with a large quantity of larvæ to feed, the bees will not at such times uncap the sealed stores fast enough to keep pace with the large amount of larvæ that needs feeding. If the weather keeps backward after that, so that the bees get little or no honey, they will begin to drag out some of the larvæ, and a little later on we find starved brood. The larvæ that are lost at such times are the very life blood of the honey business."

It is particularly important that this condition should not be allowed to occur in an apiary affected with European Foul Blood, because the larvæ need the very best care to enable them to resist the disease germs which may be present. Italian bees, well looked after at this time, will usually get through to the main honey flow all right, and after that they are safe.

A favorable locality provides a continuous supply of nectar and pollen from natural sources throughout the spring, except in cases of adverse weather, as mentioned by McEvoy above. The beekeeper will need to understand his own locality fairly well to know whether this continuous supply is available. It takes five or six weeks from the laying of the egg for the worker to become a field gatherer. Active brood-rearing should begin then, at least six weeks previous to the opening of the main honey flow, and should be continuous, without any break, until the honey flow starts.

The impulse to collect dust of some kind and carry it to the hive as pollen in the spring seems very strong. When warm days come early, so that bees are active before any pollen-bearing flowers are in bloom, they will be seen collecting sawdust, coaldust, and have even been known to collect black earth and embryo cheese mites. For fifty years or more, writers have advised feeding flour or meal of various kinds to the bees at this time, considering that it stimulated brood-rearing. Some placed it in the cells of combs which were put in the hive, others in shallow boxes, where the bees could have access to it. To keep bees home in rough weather, it was advised to make soft candy of meal, pulverized sugar, honey and water, knead it into a stiff dough and put into an open-work sack. This was first dipped into hot water and out again quickly, then laid over the frames where the cluster could reach it. It supplied both sweet and pollen substitute.

Cheshire mixed pea flour with syrup and spread it over the surface of an empty comb, which he placed in the brood-chamber, and found that the bees used

it as pollen, and whereas they had been neglecting their brood previously, the brood afterwards assumed a well-fed appearance, and they even resumed comb-building, which they had stopped for lack of pollen in their feed.

It is quite likely, however, that opening hives for such experiments so early in the spring, will do more harm than good. It is better to see that there is some pollen in each brood-chamber in the fall, and depend on the colony collecting from natural sources early enough in the spring. The practice of placing meal out for bees to gather on early warm days is also of doubtful value. It causes considerable excitement, and must use up colony vitality rapidly.

It is probably true that where the spring pasturage is poor and the main flow comes early, spring feeding is unavoidable. It was an old rule in some parts of Europe that every beekeeper must have three years' store of bee feed in advance, and this used to be stipulated in the marriage settlement.

When once begun stimulative feeding must be kept up until the honey flow starts. One objection that has been raised to early feeding is that it excites the bees to rush out, and if the weather is too cool for them to fly normally, they become chilled and do not get back to the hive. This can be obviated by always giving the feed in the evening, when it is getting dark and bees are settling down for the night. It is a safe rule in Ontario not to start this until a check comes in the flow from fruit bloom. Then, where practicable, it might be taken up and continued until the clover flow starts.

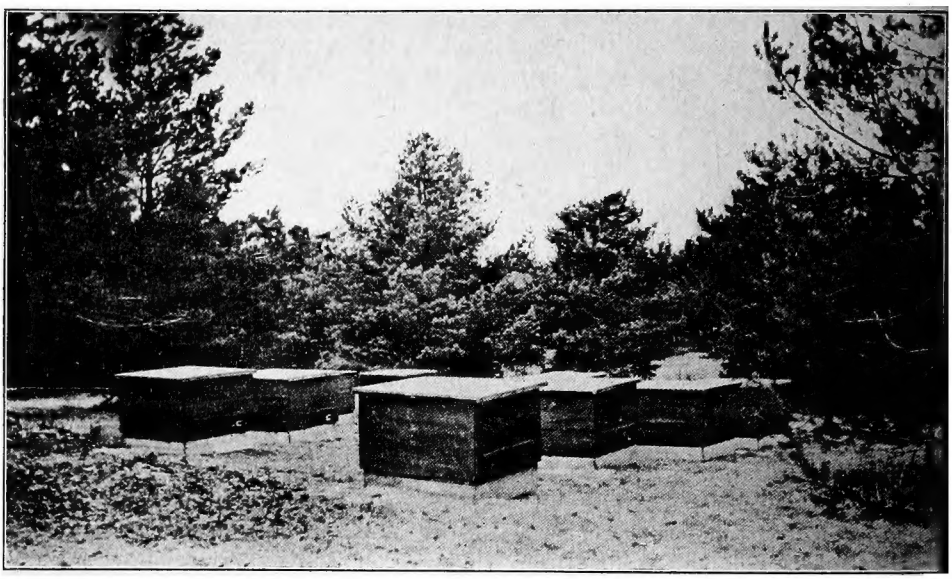
The simplest plan, where there is a plentiful supply of sealed honey in the hive, is to visit each hive once in three or four days and scrape the cappings of one comb of honey, placing it next to the brood. The bees will immediately move this leaking honey, storing it around the brood, and the process will stimulate the production of milk food and result in a better feeding of both brood and queen. If combs of capped honey are not available, empty combs may be filled with syrup, made of sugar and water in equal proportions. The filling of these combs presents a difficulty which Doolittle has overcome in a very simple way. He takes a common milk pan, punches the bottom full of holes, places this in a board having a hole cut out of it, so that the pan will stand in the hole. Nail the board to the work-bench, having the ends projecting out; set a wash-tub underneath to catch the drip. An assistant now pours the syrup into the pan, while the comb is held horizontally underneath to catch the numerous small streams of syrup.

Another simple method of stimulative feeding is to tip each hive back a little, so the rim of the bottom board forms a shallow container. Half a pint of syrup is poured in the entrace by means of a funnel. This must, of course, be done in the evening to avoid robbing.

Numerous feeders of considerable merit are sold by supply dealers, such as the Division Board Feeder, Atmospheric Feeder, Boardman Feeder, Alexander Feeder, etc.

There is no doubt that colonies may be stimulated to more rapid growth by skilful feeding, but the beginner will do well to experiment carefully, and the extensive beekeeper usually considers that it is too much work and travel to give feed to hundreds of colonies in different apiaries every evening for a few weeks. The labor required in preparing bees for successful wintering will simultaneously prepare them to reach the next harvest in prime condition. Fall conservation of vitality and stores is productive of better results than spring stimulation, and without the latter's cost in time, labor and risk. Much depends on colonies being in prime condition in the fall. This includes not only plenty of stores, but a

vigorous queen and populous colonies. By careful management practically every colony in the yard can be in such condition, and then there is very little need of stimulative feeding, unless very unfavorable weather comes between fruit bloom and the opening of clover; but the man who takes it for granted that because he fed his colonies in the fall until all had a certain quantity they will need no feeding in the spring, may meet with great losses. It is just another illustration of the fact that a man's success does not depend on the amount of manual labor he does, but on the amount of skill and carefulness with which that labor is performed.



Ontario Agricultural College Apiary in Winter.

CONCLUSION.

Bees may be wintered successfully in any part of Ontario either in cellars o out of doors. Where the cellar has given good results its use may well be continued but the beginner is advised to pack his bees on summer stands.

Beekeeping requires less financial investment than other branches of agricul ture in comparison with the returns. Expense should, therefore, not be spare in equipment, especially for winter protection.

Preparations for winter and spring should begin early in the honey seaso by looking after the queen condition of each colony during the honey flow. Ampl fall feeding, to avoid all chances of starvation in winter or spring, will be wel repaid.

Usually spring feeding is better done in autumn. Where a large number o colonies are winter packed, however, it will do no harm and will usually be bene ficial to place a ten-pound feeder of syrup on each colony in the packing case i April. This can be done by means of the feeder-boards and style of packing cas described in this bulletin, without losing any of the cluster heat. The bees shoul then be disturbed as little as possible until queen clipping time in May.